Again, from the expressions for

$$\gamma_0^2 \sin(2g_0+2l_0),\ \gamma_0^2\cos(2g_0+2l_0),$$

$$\gamma_0^2\cos(2g_0+2l_0-2g-2l) = \gamma^2+\frac{5}{4}\gamma^2e^2\cos 2g$$
$$+\left(\frac{5}{4}\gamma^4e^2-\frac{5}{32}\gamma^2e^4\right)+\left(\frac{5}{2}\gamma^4e^2-\frac{5}{16}\gamma^2e^4\right)\cos 2g$$
$$+\frac{25}{64}\gamma^2e^4\cos 4g+\frac{5}{4}\gamma^2ee'\frac{a}{a'}\cos\chi$$
$$+\frac{5}{3}\gamma^2ee'\frac{a}{a'}\cos(\chi-2g)$$

and

$$\gamma_0^2\sin(2g_0+2l_0-2g-2l) = -\frac{5}{4}\gamma^2e^2\sin 2g$$

$$\therefore\ \gamma_0^2(1-\cos(2g_0+2l_0-2g-2l)) = \frac{25}{64}\gamma^2e^4(1-\cos 4g)$$

$$\therefore\ \gamma_0^2 = \gamma^2+\frac{5}{4}\gamma^2e^2\cos 2g+\left(\frac{5}{4}\gamma^4e^2+\frac{15}{64}\gamma^2e^4\right)$$
$$+\left(\frac{5}{2}\gamma^4e^2-\frac{5}{16}\gamma^2e^4\right)\cos 2g+\frac{5}{4}\gamma^2ee'\frac{a}{a'}\cos\chi$$
$$+\frac{5}{3}\gamma^2ee'\frac{a}{a'}\cos(\chi-2g).$$

Correctly, therefore, to the fourth order e_0^2 must lie between

$$e^2\pm 5\gamma^2e^2+5ee'\frac{a}{a'}$$

and γ_0^2 between

$$\gamma^2\pm\frac{5}{4}\gamma^2e^2$$

This result bears some resemblance to planetary theory.

The conditions of the problem would be approximately realised for a small satellite of *Neptune's* revolving near the surface of its primary.

Mean Areas and Heliographic Latitudes of Sun-spots in the year 1893, *deduced from Photographs taken at the Royal Observatory, Greenwich, at Dehra Dûn (India), and in Mauritius.*

(*Communicated by the Astronomer Royal.*)

The results here given are in continuation of those printed in the *Monthly Notices*, vol. lv. p. 150, and are deduced from the measurements of solar photographs taken at the Royal Observatory, Greenwich, at Dehra Dûn, India, and at the Royal Alfred Observatory, Mauritius.

Table I. gives the mean daily areas of umbræ, whole spots, and faculæ for each synodic rotation of the Sun in 1893, and Table II. gives the same particulars for the entire year 1893 and for the four preceding years for the sake of comparison. The areas are given in two forms. First, projected areas—that is to say, as seen and measured on the photographs—these being expressed in millionths of the Sun's apparent disc; and next, areas as corrected for foreshortening, the areas in this case being expressed in millionths of the Sun's visible hemisphere.

Table III. exhibits for each rotation in 1893 the mean daily area of whole spots, and the mean heliographic latitude of the spotted area, for spots north and for spots south of the equator, together with the mean heliographic latitude of the entire spotted area, and the mean distance from the equator of all spots; and Table IV. gives the same information for the year as a whole, similar results for 1889, 1890, 1891, and 1892 being added, as in the case of Table II. Tables II. and IV. are thus in continuation of the similar tables for the years 1874 to 1888, on pp. 381 and 382 of vol. xlix. of the *Monthly Notices*.

The rotations in Table I. and Table III. are numbered in continuation of Carrington's series (*Observations of Solar Spots made at Redhill*, by R. C. Carrington, F.R.S.), No. 1 being the rotation commencing 1853 November 9. The assumed prime meridian is that which passed through the ascending node at mean noon on 1854 January 1, and the assumed period of the Sun's sidereal rotation is 25·38 days. The dates of the commencement of the rotations are given in Greenwich civil time, reckoning from mean midnight.

TABLE I.

No. of Rotation.	Date of Commencement of each Rotation.	No. of Days on which Photographs were taken.	Mean Daily Areas. Projected. Umbræ.	Projected. Whole Spots.	Projected. Faculæ.	Corr. for Foreshortening. Umbræ.	Corr. for Foreshortening. Whole Spots.	Corr. for Foreshortening. Faculæ
	1892.							
525	Dec. 27·20	28	191	1190	1965	134	856	2096
	1893.							
526	Jan. 23·53	27	343	2122	2360	249	1571	2430
527	Feb. 19·87	26	223	1256	2092	154	907	2236
528	Mar. 19·20	28	228	1496	2290	162	1114	2367
529	Apr. 15·48	27	296	1886	2477	202	1342	2518
530	May 12·72	27	285	1959	2897	203	1456	2955
531	June 8·92	26	190	1329	2691	144	1085	2844
532	July 6·12	27	344	2150	2628	244	1574	2755
533	Aug. 2·33	28	532	3215	2949	381	2383	3152
534	Aug. 29·57	27	428	2544	2286	303	1802	2460
535	Sept. 25·84	27	335	1799	2313	253	1411	2458
536	Oct. 23·13	27	302	1662	1629	212	1197	1685
537	Nov. 19·43	28	319	2075	1259	233	1514	1351

TABLE II.

Year.	No. of Days on which Photographs were taken.	Mean Daily Areas. Projected. Umbræ.	Projected. Whole Spots.	Projected. Faculæ.	Corr. for Foreshortening. Umbræ.	Corr. for Foreshortening. Whole Spots.	Corr. for Foreshortening. Faculæ.
1889	360	17·9	103	107	13·1	78·0	131
1890	361	21·3	133	273	15·5	99·4	304
1891	363	120	745	1322	86·2	569	1412
1892	362	255	1596	3230	186	1214	3270
1893	362	327	1983	2287	234	1464	2404

TABLE III.

No of Rotation.	Date of Commencement of each Rotation.	No. of Days on which Photographs were taken.	Spots North of the Equator. Mean of Daily Areas.	Spots North of the Equator. Mean Heliographic Latitude.	Spots South of the Equator. Mean of Daily Areas.	Spots South of the Equator. Mean Heliographic Latitude.	Mean Heliographic Latitude of Entire Spotted Area.	Mean Distance from Equator of all Spots.
	1892.							
525	Dec. 27·20	28	183	+15·20	674	−16·91	−10·06	16·55
	1893.							
526	Jan. 23·53	27	318	+16·84	1253	−16·69	− 9·91	16·72
527	Feb. 19·87	26	411	+11·42	497	−14·52	− 2·79	13·12
528	Mar. 19·20	28	478	+15·63	636	−14·82	− 1·77	15·17
529	Apr. 15·48	27	580	+17·26	762	−16·90	− 2·13	17·06
530	May 12·72	27	453	+17·25	1002	−18·58	− 7·42	18·16
531	June 8·92	26	262	+14·35	822	−16·71	− 9·21	16·14
532	July 6·12	27	607	+14·44	967	−17·10	− 4·95	16·08
533	Aug. 2·33	28	632	+14·93	1751	−16·08	− 7·87	15·78
534	Aug. 29·57	27	538	+12·23	1264	−11·72	− 4·57	11·87
535	Sept. 25·84	25*	842	+12·04	474	−12·40	+ 3·23	12·17
536	Oct. 23·13	27	389	+15·18	808	− 8·30	− 0·67	10·54
537	Nov. 19·43	28	781	+18·52	733	− 7·06	+ 6·14	12·98

TABLE IV.

Year.	No. of Days on which Photographs were taken.	Spots North of the Equator. Mean of Daily Areas.	Spots North of the Equator. Mean Heliographic Latitude.	Spots South of the Equator. Mean of Daily Areas.	Spots South of the Equator. Mean Heliographic Latitude.	Mean Heliographic Latitude of Entire Spotted Area.	Mean Distance from Equator of all Spots.
1889	360	5·0	+ 7°·26	73·0	−11·90	−10·68	11°·61
1890	361	53·1	+22·20	46·3	−21·75	+ 1·73	21·99
1891	363	401	+20·49	169	−19·91	+ 8·52	20·31
1892	362	607	+15·09	607	−21·69	− 3·29	18·39
1893	360*	517	+14·91	941	−14·26	− 3·93	14·49

The principal features of the sun-spot record for 1893, as brought out by the above tables, are :—

(1) The increase in the mean daily area of umbræ and whole spots has been still continued, but in a greatly diminished ratio.

* The photographs on two days, October 20 and 22, have been used for the areas of the sun-spots, but not for their positions.

(2) But the mean daily area of the faculæ has undergone a notable decline.

(3) The predominance as to spotted area has changed over definitely from the northern hemisphere to the southern.

(4) The mean daily spotted area has actually declined for the northern hemisphere as compared with 1892, the increase recorded for the whole disc being entirely due to the great activity of the southern hemisphere.

(5) The mean distance from the equator of all spots has reached the zone usually occupied at maximum, and, indeed, for the last four rotations of the year, has considerably overpassed it. The extraordinary outburst of 1893 August, which was followed so promptly by this decline in latitude, probably marks, therefore, the actual crest of the curve at maximum.

(6) The decline in latitude has been mainly witnessed in the southern hemisphere, and set in, as just stated, immediately after the close of the great outburst for that hemisphere in August.

(7) On the whole the maximum as to spotted area appears to have fallen in 1893 August, both for the southern hemisphere and for the Sun as a whole. For the northern hemisphere considered separately, it seems to have fallen nearly fourteen months earlier, towards the end of June or beginning of July 1892.

Royal Observatory, Greenwich:
1895 *October* 28.

Diameters of Saturn and his Rings, observed at the Royal Observatory, Greenwich, during the Opposition of 1895.

(*Communicated by the Astronomer Royal.*)

Measures of *Saturn's* rings and of equatorial and polar diameters were made with the filar micrometer on the 28-inch refractor during the months of April, May, and June 1895, the full aperture being used in all cases.

The distances of the edge of the outer ring, of the centre of Cassini's division, of the edge of the inner bright ring, and of the crape ring were measured from the nearer and further limbs of the planet, both on the preceding and following sides; the mean of two such measures giving the radius of a ring, and the difference giving the equatorial diameter of *Saturn*. Direct measures were also made of the polar diameter and of the width of Cassini's division. The latter was sharply defined, and was easy to measure, and seemed a little more distinct on the following than on the preceding side. Encke's division was seen at both ansæ on June 12 by the Astronomer Royal and Mr. Lewis.

The results obtained on the separate nights are given in the following table, as well as the number of separate determinations of each result. In the column "Observer" D denotes Mr. Dyson, and L Mr. Lewis. The measures have all been reduced to a mean distance of 9·53885, and the polar diameters have been corrected for the elevation of the earth above the plane of the ring.